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IMMEDIATE WATER POLLUTION CONTROL NEEDS VERDIGRIS RIVER BASIN, KANSAS AND OKLAHOMA

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
DALLAS, TEXAS

APRIL 1967

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VERDIGRIS RIVER BASIN

KANSAS AND OKLAHOMA

UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTH CENTRAL REGION
DALLAS, TEXAS

April 1967

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This report focuses attention on known sources of pollution and provides a priority for action to correct existing water pollution problems and prevent future problems in the Verdigris River, an interstate stream, and its tributaries. Pollution problems indicated by septic conditions, oxygen depletion, and high sulfate, chloride, and dissolved solids concentrations, are degradation of aesthetics, damages to propagation of fish life, degradation of municipal and industrial water supplies, and impairment of water for recreational uses. Immediate pollution control needs are in waste treatment, flow regulation, institutional practices, and research.

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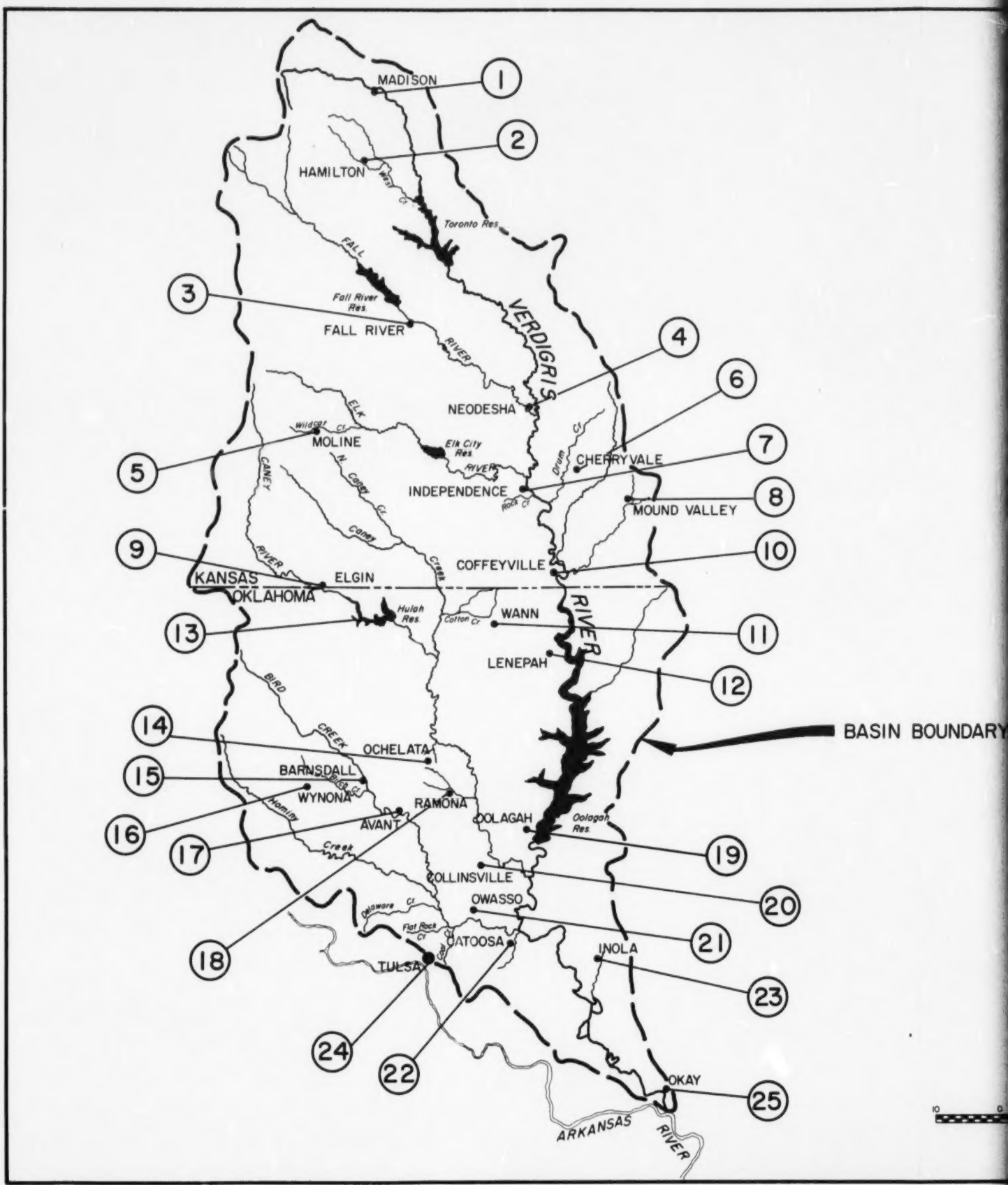
I. Introduction

The purpose of this report is to focus attention on known sources of pollution and to provide a priority for action to correct the existing water pollution problems and prevent future problems in the Verdigris River (see figure 1), an interstate stream, and its tributaries. This report is based on compilations of available data of the Federal Water Pollution Control Administration, South Central Region, and the State agencies of Kansas and Oklahoma with responsibilities in water pollution control. No detailed water quality surveys or engineering studies were carried out for the preparation of this report.

The findings of this report are based on the best information available at this time on water quality conditions and immediate and potential pollution abatement needs. The omission of any particular town, industry, or other source of pollution from this report is not intended to imply that an immediate or potential abatement need does not exist in that particular area. Priorities listed are based solely on an evaluation of the Verdigris River Basin and not on a relative basis with other basins in the South Central Region.

Authority is given in section 3 (a) of the Federal Water Pollution Control Act, as amended, for the preparation or development of comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries thereof and improving the sanitary conditions of surface and underground waters. This report, by describing the immediate needs for controlling water pollution in the Verdigris River Basin, represents the first step in the development of a comprehensive program to control water pollution in this basin.


MADISON
1
2
HAMILTON
West Cr.
Toronto Res.
FALL
3
Fall River Res.
FALL RIVER
VERDIGRIS
RIVER
4
6
NEODESHA
ELK
Wildcat Cr.
MOLINE
5
Elk City Res.
RIVER
CHERRYVALE
7
Drum Cr.
CANEY
N. Caney Cr.
INDEPENDENCE
Rock Cr.
8
MOUND VALLEY
Caney
Creek
9
RIVER
COFFEYVILLE
10
KANSAS
OKLAHOMA
ELGIN
Hulah Res.
13
Cotton Cr.
WANN
11
RIVER
LENEPAH
12
BIRD
CREEK
BASIN BOUNDARY
14
OCHELATA
15
BARNSDALL
Bigheart Cr.
WYNONA
16
Hominy
RAMONA
AVANT
17
OOLAGAH
Oologah Res.
19
Creek
COLLINSVILLE
20
Delaware Cr.
OWASSO
21
Flat Rock Cr.
CATOOSA
INOLA
18
TULSA
Fork
23
24
22
OKAY
25
ARKANSAS
RIVER

VICINITY MAP

LEGEND

(1) NEEDS

BASIN BOUNDARY

SCALE IN MILES

10 0 10 20 30 40

IMMEDIATE WATER POLLUTION CONTROL NEEDS
VERDIGRIS RIVER BASIN — KANSAS AND OKLAHOMA

LOCATION MAP

UNITED STATES DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
SOUTH CENTRAL REGION APR 1967 DALLAS, TEXAS

FIGURE 1

II. Summary of Immediate Pollution Control Needs

Pollution problems in the Verdigris River Basin, indicated by septic conditions, oxygen depletion, high sulfate, chloride, and dissolved solids concentrations, are degradation of aesthetics, damages to propagation of fish life, degradation of municipal and industrial water supplies, and impairment of water for recreational uses. The immediate pollution control needs are listed in the following tabulation and grouped into categories: waste treatment, flow regulation, other pollution control practices, institutional practices, and research. Location designations refer to figure 1.

Location	Responsibility	Need	Priority
Waste Treatment			
1	City of Madison, Kansas	Replace existing secondary plant	B
2	City of Hamilton, Kansas	Replace existing secondary plant	B
3	City of Fall River, Kansas	Primary and secondary treatment	B
4	City of Neodesha, Kansas	New primary and secondary plant	B
5	City of Moline, Kansas	Replace existing secondary plant	B
6	City of Cherryvale, Kansas	Expansion of secondary treatment	B
7	City of Independence, Kansas	Replace existing secondary plant	B
8	City of Mound Valley, Kansas	Primary and secondary treatment	B
9	City of Elgin, Kansas	Secondary treatment	B
10	Cooperative Oil Refinery, Coffeyville, Kansas	Expansion of treatment facilities	A

Location	Responsibility	Need	Priority
Waste Treatment (Continued)			
11	City of Wann, Oklahoma	Primary and secondary treatment	B
12	City of Lenepah, Oklahoma	Primary and secondary treatment	B
13	U. S. Army Corps of Engineers, Recreation Area, Hulah Reservoir, Oklahoma	Concrete vaults at rest areas	B
14	City of Ochelata, Oklahoma	Primary and secondary treatment	B
15	City of Barnsdall, Oklahoma	Secondary treatment	B
16	City of Wynona, Oklahoma	Secondary treatment	B
17	City of Avant, Oklahoma	Secondary treatment	B
18	City of Ramona, Oklahoma	Primary and secondary treatment	B
19	City of Oolagah, Oklahoma	Primary and secondary treatment	B
20	City of Collinsville, Oklahoma	Expansion of secondary treatment	B
21	City of Owasso, Oklahoma	Expansion of secondary plant	B
22	City of Catoosa, Oklahoma	Primary and secondary treatment	B
	Port of Catoosa, Oklahoma	Primary and secondary treatment	B
23	City of Inola, Oklahoma	Expansion of secondary plant	B

Location	Responsibility	Need	Priority
Waste Treatment (Continued)			
23	City of Okay, Oklahoma	Primary and secondary treatment	B
Flow Regulation			
24	Corps of Engineers	Bird Creek - storage to provide a supplemental flow for dilution of Tulsa, Oklahoma waste effluent	A
Other Pollution Control Practices			
Basinwide	Feedlot Operators	Interception of feedlot runoff	A
Basinwide	States of Kansas and Oklahoma, and oil interests	Plugging of abandoned oil wells	A
24	City of Tulsa, Oklahoma	Improved operation and maintenance of treatment plants	A
Institutional Practices			
Basinwide	States of Kansas and Oklahoma	Establish feedlot regulations	A
Basinwide	States of Kansas and Oklahoma	Increase budget and staffing of agencies involved in oil field pollution control	A
Basinwide	State of Oklahoma	Prepare and maintain a complete industrial waste discharge inventory	B
Basinwide	States of Kansas and Oklahoma	Establish water quality standards	B
Basinwide	States of Kansas and Oklahoma	Expand water quality monitoring network and staff to enforce water quality standards	A

Location	Responsibility	Need	Priority
Institutional Practices (Continued)			
Basinwide	States of Kansas and Oklahoma	Consider legislation to provide appropriations for State participation in grants for construction of sewage treatment works	B
Research			
Basinwide	States of Kansas and Oklahoma, FWPCA, and Universities in area	Means to control and/or treat feedlot runoff	A

III. Immediate Control Needs

Various measures are needed to control existing and potential water pollution of the Verdigris River and its tributaries. These measures are needed to abate septic conditions, increase oxygen content, reduce concentrations of toxic materials, chlorides, sulfates, and dissolved solids for the protection of water uses within the basin. The uses that will benefit by such actions are: municipal and industrial water supply, propagation of fish and wildlife, recreation, and navigation.

The actions recommended here, though not all encompassing, are, however, prerequisite to good water quality planning and should be included in local, State, and Federal programming for water pollution control. Background for these immediate needs is summarized in Chapter VI.

Waste Treatment

New or expanded treatment facilities are needed by at least 23 communities, one industry, and one Federal reservoir (as listed in the summary table). The list of needs is not considered all inclusive and does not reflect projected needs due to future obsolescence or to expanded or changed water uses.

The Cooperative Oil Refinery near Coffeyville, Kansas, needs additional treatment of waste effluents for the removal of phenols.

Flow Regulation

Reservoir storage in the Bird Creek watershed is currently needed to supplement low flows in the stream and increase capacity for assimilation of treated waste effluents from the City of Tulsa, Oklahoma. An authorized multipurpose Corps of Engineers reservoir on Hominy Creek could provide the average annual supplemental flow of approximately 8 cubic feet per second needed.

Other Pollution Control Practices

Interception of storm runoff from many large cattle feedlots in the basin by the construction of lagoons or holding ponds for treatment and/or land disposal is immediately needed as a first step in preventing the gross pollution of many surface streams that is presently occurring.

The plugging of abandoned oil wells to prevent pollution of surface or ground water supplies is needed where reinjection of oil

field brines for disposal and water flooding operations causes or may cause brine to reappear in improperly plugged wells.

The City of Tulsa, Oklahoma, needs to improve operation of the Coal Creek and Flat Rock Creek sewage treatment plants to increase treatment efficiency.

Institutional Practices

A permit system as currently proposed by the Kansas Department of Health is needed in Kansas and Oklahoma to prevent and abate surface water pollution from feedlot runoff.

The States of Kansas and Oklahoma need an increase in budget appropriations for agencies concerned with oil field pollution to increase their staffs and to make funds available for plugging of abandoned problem oil wells where a responsible party cannot be ascertained.

To strengthen the states' position on prevention, control, and abatement of stream pollution, water quality standards are needed on intrastate streams. State participation is needed in the waste treatment plant construction grants program to accelerate the construction of needed improvements. Increased surveillance and operation inspection of sewage and industrial waste treatment plants are needed to locate and identify existing or potential serious pollution problems. For more rigid control over industrial pollution and aid in solving complex stream quality problems, a complete and up-to-date inventory is needed of industrial waste discharges to basin streams, listing quantity and quality of effluent and other pertinent data.

Research

Further research is needed to solve the problem of feedlot runoff pollution. In addition to means to control and/or treat runoff, which should solve the immediate problem, pollution to ground water supplies and nutrient buildup in streams and reservoirs are two of the many other potential problems.

IV. Costs

The estimated cost of pollution control measures listed in the summary table is shown in the following tabulation:

Item	Estimated Cost
Waste Treatment Facilities	
New treatment facilities	$2,170,000
Expansion and improvements	430,000
Subtotal	$2,600,000
Federal Reservoirs	
Concrete Vaults in rest areas at Hulah Reservoir	$ 30,000
Storage for water quality control	2,000,000
Subtotal	$2,030,000
Agricultural Pollution	
Feedlot runoff control	$ 50,000
TOTAL	$4,680,000

Of the total cost, approximately $2,200,000, exclusive of research and institutional costs, would be needed for control measures listed under priority "A" in the summary table.

V. Recent Progress in Pollution Control

State

The States of Kansas and Oklahoma have made significant progress in recent years to control water pollution in the basin through surveillance, construction of treatment facilities, training programs, stream monitoring networks, and inspection of treatment plant operation.

Pollution by oil field brines in Kansas and Oklahoma has been greatly reduced through state enforcement. The Corporation Commission of Oklahoma recently issued an order that all earthen pits used for the handling, storage, or disposal of deleterious substances produced in connection with the operation of oil wells or refineries shall be sealed with an imperious material and that any flow from these pits be prevented. These actions have reduced chloride and solids' concentrations, though not yet to generally acceptable levels.

In addition, both states in the basin are preparing water quality standards for all interstate streams.

Federal Agencies

Through a continuing construction grants program, treatment facilities and appurtenant works have been constructed at 18 towns and cities in the basin in recent years, thus reducing pollutional discharges to basin streams.

The Arkansas-Red River Basins study completed in 1964 was a cooperative study between numerous Federal, State, and local agencies concentrating on abatement of natural and manmade brines in these two basins, which includes the Verdigris River Basin.

A report completed in May 1966 by the Federal Water Pollution Control Administration studied the need for and value of storage for water quality control in several authorized U. S. Army Corps of Engineers' reservoirs in the lower Verdigris River Basin.

An investigation of water pollution control and water quality in the Arkansas River and its tributaries from Keystone Dam above Tulsa to the Arkansas state line was begun by the Federal Water Pollution Control Administration in 1964 at the request of and in cooperation with the Interagency Water Pollution Control Coordinating Committee of the State of Oklahoma. This investigation included an extensive water pollution survey of the lower Verdigris River.

Research

The University of Kansas and Kansas State University have current research projects on the control and treatment of feedlot wastes. These projects are sponsored by grants from Federal and State government, and agricultural interests.

VI. Background

Pertinent Basin Characteristics

The Verdigris River Basin lies in eastern Kansas and Oklahoma and drains a total area of approximately 8,300 square miles, 5,000 square miles in Kansas and 3,300 square miles in Oklahoma (see figure 1). The river rises near Madison, Kansas, and flows 350 miles southward to join the Arkansas River at Muskogee, Oklahoma. The basin is not heavily populated. The largest communities lying entirely within the basin are Bartlesville, Oklahoma, (27,893); Coffeyville, Kansas, (17,382), and Independence, Kansas, (11,222). The City of Tulsa, Oklahoma, 1960 population of 261,685, lies partly in the basin. The primary economic activities in the basin are farming and raising of livestock and petroleum production and refining operations.

Streamflow in the basin is highly variable. The yearly average flow of the Verdigris River at Independence, Kansas, is 1,606 cfs but extremes range from 117,000 cfs to zero. Due to low base flows, most reaches of the Verdigris River have experienced periods of zero flow, some stream gages recording frequent and extended periods of no flow.

There are five major U. S. Army Corps of Engineers' projects in the basin. Toronto, Fall River, Elk City, and Hulah reservoirs provide storage for flood control, water supply, low flow releases, and recreation. Oologah Reservoir has initial storage for flood control, water supply, and recreation, with ultimate development to include hydroelectric power generation and storage for navigation on the Verdigris and Arkansas Rivers.

The surface water resources are an important asset to the basin and are used primarily for municipal and industrial water supplies, fish and wildlife propagation, agriculture, recreation, and navigation.

The Arkansas River Navigation System, scheduled for completion in 1970, will extend up the Verdigris River to its termination at Catoosa, Oklahoma. Not only is the Verdigris River apt to become the busiest canal within the Arkansas system, but it could also become one of the most difficult streams to establish control on water quality within the State of Oklahoma. Navigation channel modifications on the Verdigris will result in slowing the recovery from degradation by treated waste releases from the Tulsa area water pollution control plants.

Water Quality

The average chemical quality of the ground and surface waters of the Verdigris River Basin is good, although relatively high in hardness. Presented below is the quality of the Verdigris River during water year 1964 at two locations.

Location	Weighted Average (ppm) Sulfates	Chlorides	Dissolved Solids	Hardness as $CaCO_3$
Verdigris River At Independence, Kansas	33	96	368	187
Verdigris River near Inola, Oklahoma	35	94	310	136

During periods of low flow the Public Health Service Drinking Water Standards are greatly exceeded, as shown below:

Location	Date	Flow (cfs)	Chemical Concentration (ppm) SO_4	Cl	D.S.	$CaCO_3$
Verdigris River near Inola, Oklahoma	10, 10-14, 1963	22.2	54	630	1400	334

Present Water Quality Problems

Pollution of streams in the Verdigris River Basin at the present time is not a severe problem because of the comparatively small population and industrial development. Lack of high sustained flows in the basin, however, have caused problems of localized pollution from inadequate or overloaded municipal and industrial treatment facilities and spills from petroleum production during periods of low or zero flows.

Bird Creek below Tulsa, Oklahoma

The City of Tulsa currently has three treatment plants serving approximately 50 percent of the city's rapidly expanding metropolitan population (1966 est. 366,000) which discharge to Bird Creek. These three plants have a combined discharge of approximately 12 million gallons per day. Although the wastes discharged receive secondary treatment, Bird Creek is inadequate to assimilate these wastes during periods of low stream flow, The resulting low dissolved oxygen levels and high coliform counts damage the stream for fish and wildlife, water supply and recreation uses.

Oil Field Brines

In the past, the major source of water pollution in the Verdigris River Basin has been the surface disposal of brines brought to the surface in oil well operations. The situation has improved greatly in recent years through the enforcement of state laws forbidding surface disposal of oil field brines, and it is now estimated that 99.5 percent of the brines in Kansas and 95.0 percent of the brines in Oklahoma are reinjected into the ground. However, the reinjection of brines for disposal and water flooding operations sometimes create new problems. An abandoned well in an oil field currently producing may allow brines to reach the surface or reach a fresh water aquifer if it is not properly plugged, thus causing a large increase in the concentrations of chloride, sulfates, and dissolved solids in ground and surface water supplies.

Feedlot Runoff

Animal wastes have long been identified as significant sources of pollution. Fortunately, however, the animal population is normally dispersed over large areas and wastes produced remain on land or are stabilized prior to reaching a stream. However, in feedlot operations where large numbers of animals are kept in a very small area, serious waste disposal problems can result.

Cattle feeding is not as significant in the Verdigris River Basin as in other parts of Kansas and Oklahoma. There are about 21 lots with over 300 feeding capacity in the area. These 21 lots have combined capacities to feed about 19,000 head. Most of the larger lots are located in the Kansas portion of the Verdigris River Basin. Three small fish kills were caused by feedlot runoff on tributaries to the Verdigris in 1964. These kills were believed caused by a depletion of dissolved oxygen in the streams as a result of the high organic waste carried in the runoff from cattle feedlot areas.

Verdigris River below Coffeyville, Kansas

Taste and odor problems in municipal water supplies have been reported by several communities who withdraw water from the Verdigris River in Oklahoma. This cause of these complaints are thought to be pollution originating from the oil refineries at Coffeyville.

Other Areas

Throughout the Verdigris Basin there are many small problems of water pollution in streams receiving waste discharges from communities and industries having inadequate treatment facilities. These are tabulated in the summary table and are shown on figure 1.

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